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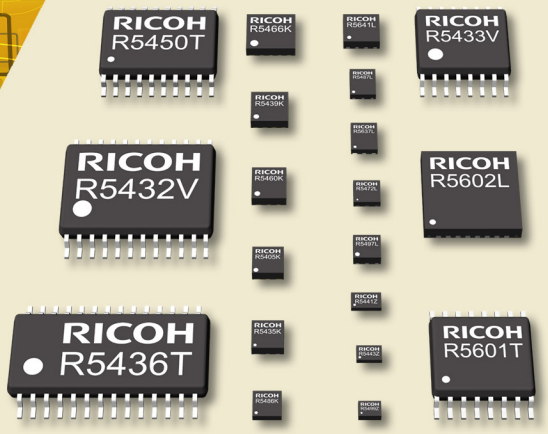
Li-Ion Battery Management ICs



1-Cell Protection
2-Cell Protection
Multi-Cell Protection
Secondary Protection
Analog Front End

www.n-redc.co.jp/en/

Lithium-Ion Battery Protection ICs

In the early 1990's, the first commercial Li-Ion batteries were launched to the market. Ricoh Electronic Devices Company was one of the first pioneering companies developing a single chip protection IC to maintain the charging and discharging process within the safety margins. Ricoh has over 25 years of experience with these products and is continuously searching for new innovative features to fulfil to safety standards, reduce current consumption and to extend the battery lifetime. Today we are one of the market leaders of Li-Ion and Li-Polymer protection ICs used in a large variety of products and markets.

1-Cell Protection ICs

Our portfolio of 1-cell protection ICs has many products targeted for popular portable devices such as smartphones and smartwatches. According to an internal investigation in 2018, it is calculated that we have a global share of 17% in protection ICs for the smartphone market. Generally, we are shipping over 600 million 1-Cell protection ICs annually thanks to our long experience with these products.

In order to find a product according to your requirements, we explain a number of features to distinguish budgetary and more advanced solutions. In general, battery protection ICs detect standard fault conditions such as over-charge and over-discharge voltage, charge and discharge overcurrent and short circuit.

As for current sensing there are two options to choose from, one method uses the on-resistance of the associated MOSFET switches, while another more accurate sensing method uses an additional external current sense resistor. Another option is to select a protection IC with a so-called two-step current limit detection, meaning that the IC has different response speeds for two overcurrent levels. A normal response speed for a modest overcurrent and faster response speed for a more severe overcurrent level.

In terms of the overvoltage threshold accuracy, a significant improvement was accomplished during the past years. It is important to select a product with a high accuracy level in order to increase safety but it also allows charging the battery to a slightly higher level as there is less deviation of the overvoltage threshold setting in relation to the maximum charge voltage. An advantage is that this extends the operation period of the device. The protection ICs have an option by product version to allow or prohibit charging a cell discharged below the overdischarge threshold voltage level.

Recently, a product with a safety function has been added with a temperature sensor input to disable the IC when the cell temperature gets too high and may become dangerous to the user.

Regarding the package size, one can choose from many options according to your requirements and budget. The smallest available package measures only 0.83 x 1.1 x 0.48 mm (LxWxH), which is best suited for small rechargeable hearing aids or wireless headsets. For these devices with a small battery capacity, a product with a completely new function is introduced to force the protection IC into a low power consuming "shipping mode" to retain the battery charge for the first use when it is stored in a warehouse for a long period. An alternative version has the possibility to turn off the two MOSFET switches by an external control signal.

2-Cell and Multi-Cell Protection ICs

DSLR photo and video cameras, power tools, laptop computers, robot lawn mowers and cordless vacuum

cleaners use more powerful 2-cell and multi-cell battery packs. We have a number of products for various cell counts up to maximum 5 cells with a single IC, some products can be cascaded to support cell counts up to 10 or 15 cells. Depending on the product, a cell balancing function is available as well to equalize any unbalance between various cells. Especially for Power Tool devices, which are used in a harsh environment, there is a possibility that the internal wiring of the battery pack may be broken due to a shock or vibration. In such a case, protection ICs cannot monitor the state of battery cells and therefore cannot judge whether the battery is safe to use or not. Protection ICs with an open-wire detection function monitor the connection with battery cells periodically and prohibits charging and discharging when detected an open wire.

Secondary Protection ICs

This kind of products are in particular developed for devices requiring additional safety measures. The secondary protection circuit kicks in when the primary protection circuit fails due to any reason. It monitors an overcharge condition only and once triggered it blows an internal fuse and terminates the use of the battery pack permanently. The malfunctioning battery pack needs to be replaced by a new one. We have various ICs available for cell counts from 1 to 5 cells and features like a cascade option and a temperature sensor input.

Analog Front End Protection ICs

All previous mentioned solutions in this article refer to so-called stand-alone ICs, meaning that a single IC does the detection and interruption control. Battery protection circuits with an Analog Front End IC only perform cell measurements and use an additional Microcontroller, A/D Converter and software to control the interruption of the charging and discharging process. As a result, all voltage and current thresholds as well as timing settings are specified by software which makes the design of the application more flexible and allows the designer to implement tailored functions and algorithms. Our newest Analog Front End IC for 4 - 7 cells offers advanced features such as a high speed cell voltage sampling rate, integrated 12bit A/D Converter, selectable I²C or SPI bus interface to exchange measurement results and additional control of functions, two temperature sensor inputs, high-side MOSFET control, open-wire breaking detection, cell balancing and a cascade function.

To increase the accuracy level of the measurements, it is essential that the Analog Front End IC and the associated MCU share the same common ground level to avoid inaccurate measurements. Therefore, we have implemented the feature to use high-side MOSFETs to control the charge and discharge process.

Traditionally the individual cells of a multi-cell battery must be connected in a specific order to avoid damage to the electronic circuit. New protection ICs now include a random cell connection function to prevent this kind of failure, which makes it easier to manufacture the battery pack.

For more information about our Li-Ion Protection ICs, please refer to our website:

https://www.n-redc.co.jp/en/products/lithium-ion-battery-protection/